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ABSTRACT

Using data gathered from the West Virginia Education and Tax Departments, from school architects, from the State Building Trades Council, and from the United States Census Bureau, this study relates the per pupil cost of new school buildings in West Virginia to financial conditions, school district demography, and building characteristics. A total of 128 elementary, secondary, and vocational-technical school buildings constructed between 1974 and 1982 were investigated using multiple regression analysis. The 11 independent variables, drawn from facility planning and finance literature, included local fiscal effort, state and federal aid, school district enrollment, urban or rural location, space allocated to instruction, construction time, and building type. Surprisingly, only the district's assessed value and local effort, the amount of state funding, and the facility type significantly affected construction costs; the other variables, contrary to common assumptions, had little effect. The importance of fiscal variables implies that West Virginia schools are of unequal quality. Therefore, a state funding formula--using the variables found significant in this study--should be devised to fund needed school construction with equal local efforts. Meanwhile, researchers should further investigate the effects of space allocation and federal funding on construction costs. (MCG)

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VARIABLES ASSOCIATED WITH PER PUPIL COSTS IN PUBLIC SCHOOL BUILDINGS

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As inflation and reduced financial support for education have severely impacted on educational spending in recent years, the need to effectively compare the cost of school construction has increased. A review of the literature has indicated a void in research which has investigated the relationship between project costs and many of the variables which have historically been attributed to the characteristic of causality. For the purpose of this study, these variables were divided into three major groups; financial, school district descriptors, and building descriptors. As such, it has been assumed that these relationships exist and operate in the determination of school construction costs. The purpose of this study was to test the relationship between these variables and the per pupil cost of new school construction.

Description of the Study Projects

The data source for this study was the new school construction projects funded through West Virginia's Better School Buildings Amendment. Data were collected from the State Department of Education and State Tax Department records; communications, both by letter and interview, with school architects; the State Building Trades Council; and publications of the U.S. Bureau of Census. One of the

purposes of the Better School Buildings Amendment was to improve the quality of educational facilities in West Virginia by providing state funds on a grant basis and additional incentive money to help generate local revenues for school construction and improvement. The Amendment was passed in November, 1972; guidelines and procedures were designed, and money was made available in mid 1973. The study group consisted of 128 elementary, secondary, and vocational-technical school facilities constructed between 1974 and 1982. The years that reported the greatest number of project completions were 1976 and 1978, both reporting 27, followed by 1980 during which 20 buildings were completed. These years are considerably above the mean of 14.22 completions per year for the entire nine-year period of time.

Adjustments to and Computations of the Dependent Variable

The nature of the problem being studied in this research was such that a multiple regression analysis provided the primary statistical result in the study. Prior to submitting the data to such an analysis, however, procedures were necessary to adjust the dependent variable, cost per pupil of construction projects completed during the past nine years, to the 1982 level. In order to achieve this, an inflation index for school construction in West Virginia was developed. In the first step of this development, means for each year's construction in cost per square foot were determined. These means were then

found to be a percentage of the 1982 mean. By dividing this percentage into 1, an inflation factor was determined for each year. Adjusting construction costs to compensate for the effect of inflation consisted of multiplying the total capital cost of each project by the inflation factor respective of its completion date.

The per pupil cost was found by dividing the adjusted figure by the rated capacity of the facility. This capacity was derived by applying the utilization guidelines recommended by the State Board of Education in The West Virginia Handbook on Planning School Facilities, and § 18-5-18a of the West Virginia Code. The utilization guidelines offer optimal capacities for secondary and vocational facilities based upon program offerings and required space. The capacities of kindergarten and elementary schools are restricted by the number of classrooms available due to § 18-5-18a of the West Virginia Code which limits the teacher/pupil ratio to 1 to 20 and 1 to 25, respectively. The product of the adjusted project cost divided by the rated capacity yielded the cost per pupil adjusted to the 1982 level which was utilized as the dependent variable in this study. Costs per pupil ranged from $3,482 to $8,003. Characteristically, vocational-technical facilities were most expensive with a mean of $6,635, secondary facilities were next with a $5,840 mean, and elementary schools were least expensive with a mean of $4,494 per pupil over the nine-year span.

Independent Variables

Selection of the independent variables resulted from the common attribution of causality in the variance of construction costs given them by authors and researchers in the field of facility planning and finance. They were categorized as either financial, characteristic of the school district, or descriptive of the individual building.

Both the expenditures of the school district and the assessed value of the district were expressed in dollars per pupil; the local effort of the school district toward facility construction was expressed as an index computed by dividing the total amount of local dollars invested by each school district in its facilities during the past 10 years by the 1981 assessed value for that district. This resulted in an index continuum which could be used in the multiple regression procedure. State, local, and federal funds were represented by the actual dollars from those sources that were contributed to the individual projects in each district.

The size of the school district was represented by the net number of pupils enrolled in the district, the average of which was 8,113 students. Examination of the Standard Metropolitan Statistical Areas--SMSA--indicated that only 25 of the 128 new facilities were built in urban districts, with a mean cost of $5,352 per pupil as compared to 103 rural schools at a mean cost of $5,060 per pupil. This revealed that 19.53 percent of the construction sites

were in the seven urban districts that reported construction. Three of the SMSA districts reported no construction.

The amount of instructional space in the facility was represented as a percentage figure and averaged 74.5 percent statewide. It was calculated by dividing the number of square feet in the buildings that were designated as instructional, by the total square feet in the facility. Instructional area included classrooms, auditoriums, gymnasiums, libraries, multipurpose rooms, administrative and counseling suites, conference rooms, health service rooms, and duplicating rooms. Excluded were furnace rooms, mechanical rooms, kitchens, dining areas, toilets, circulation space, lobbies, lounges, custodial storage space, showers, and locker rooms. Construction time was expressed by the number of weeks that were involved in completing the project. The average completion time was 75.5 weeks.

Prior to the statistical analysis, it was necessary to statistically dummy code the nominal variables, SMSA, type of facility, and geographical location. Districts located in the Bureau of Census Standard Metropolitan Statistical Areas were assigned a value of one, while rural areas were assigned a value of zero.

The type of each facility was determined and values of 1, 2, and 3 were respectively assigned to elementary, secondary, and vocational-technical projects for entry into the multiple regression.

Geographically, the boundaries of the local Building Trades Councils were utilized to locate projects throughout the state. These areas were chosen because of their obvious relationship to construction costs, wage rates, and their proximity to the geographic regions of the state.

Statistical Analysis of the Data

Having completed the necessary procedures for computing both the dependent and independent variables, the data were submitted to a regression analysis testing for the effect of the dummy coded variables, type, SMSA, and geographic area. It was found that geographic area and SMSA did not contribute significantly to the cost per pupil of new school facilities at the .05 level when entered as the final variable in the analysis and thus were omitted from later analyses.

The type of facility did show, however, a statistically significant contribution to the variance of the dependent variable ($F = 15.804$; $p < .05$). In order to determine the nature of this contribution to the regression analysis, an analysis of the covariance was utilized. In this analysis, the means of the dependent variable for the three types of schools were adjusted for the other independent variables. The result of the ANCOVA indicated there was a significant main effects F of 13.46, ($p < .001$). The Scheffe' post hoc test was done to make pair-wise comparisons of the adjusted means of the elementary,

secondary, and vocational-technical costs per pupil. The conservative Scheffe` test was chosen because of the significant F-ratio in the ANCOVA and unequal number of observations in each group. The results of the Scheffe` test indicated a statistically significant difference between the means of each of the types at the .05 level of significance.

With the initial testing of the dummy coded variables completed, the data were again submitted to the multiple regression procedure to determine the relationship between the remaining independent variables and per pupil construction costs. The interrelation of the independent variables is illustrated by the correlation matrix in Table 1. When the independent variables were simultaneously entered into the regression equation, the overall F-ratio was statistically significant ($F = 11.23$; $p < .05$), and the R^2 indicated that 53.96 percent of the variance in construction costs per pupil was attributable to the 11 independent variables. An examination of Table 2 reveals that four of the variables were contributing significantly to this variance--assessed value, local effort, state funding, and the combined type of facility. Educational expenditures, SMSA, the percent of instructional space, the length of time in construction, the amount of federal money invested, and the size of the school district as measured by net enrollments had no significant effect on the cost of construction.

Table 1

Matrix of Bivariate Correlation Coefficients Between the Total Per Pupil Cost of School Construction and Selected Variables

Variables	Ed. Expend.	Assessed Value	Local Effort	Inst. Space	Const. Time	State Funds	Federal Funds	Net Enroll.	Facility* Type
Cost Per Pupil	.096	.149	.046	-.064	.254	.422	.431	.235	.426
Educational Expenditure		.768	-.225	-.112	-.266	.091	.001	-.138	.018
Assessed Value			-.215	.053	-.228	-.023	.036	-.096	.011
Local Effort				.138	-.022	-.256	-.109	-.200	.023
Instructional Space					-.180	-.148	.295	-.183	-.161
Construction Time						.300	.141	.313	.079
State Funds							.084	.445	.305
Federal Funds								.096	.532
Net Enrollment									.042

*R scores reported for dummy coded variable

Table 2

Results of Multiple Regression Analysis Between Construction Cost and Selected Independent Variables

Variable	B	Beta	F-Ratio
Educational Expenditures	-.7183	-.1135	1.107
Assessed Value	.0243	.2993	6.056*
SMSA	-163.5260	-.0530	0.363
Local Effort	16762.49	.2158	9.162*
Instructional Percentage	-1310.626	-.0627	0.740
Construction Time	2.3312	.0719	0.954
State	.00033	.2418	7.567*
Federal	.00042	.1547	2.358
District Enrollment	.0208	.0918	1.283
Type 1 Elementary	-1603.567	-.6425	16.538*
Type 2 Secondary	-818.642	-.3037	4.204*

*Significant at α = .05; F(cv) = 3.92

In order to determine the existence of any curvilinear relationships that might have affected the multiple regression analysis, scattergrams for each of the independent variables with the dependent variable were produced. Examination revealed that no such relationships existed.

Conclusions

As a result of the findings from this study. The following conclusions were drawn:

1. The per pupil cost of school construction is significantly affected by the assessed value of the school district, the local effort of the district in facility construction, and the amount of money from the state level.

2. The type of facility, whether elementary, secondary, or vocational-technical, significantly affects the per pupil cost of school facility construction.

3. Many of the variables often given a causal relationship with school construction costs and including total education expenditures, federal funds, size of the district, geographic location, rural-urban factor, the amount of instructional space, and the length of construction time, are not significant contributors to the cost variance.

Generalization of these conclusions to other states would, in all probability, prove to be erroneous because of the uniqueness of each state's size, geography, economic status, organizational structure, and other

variables which differ from West Virginia's. Therefore, should this study be replicated in another state, it would most assuredly result in varied conclusions.

Implications

In viewing the results of this study from the state level, there are definite implications of inequity in funding school construction in West Virginia. These implications are founded in the utilization of assessed value of property as the determinant of local fiscal capacity as well as the criterion upon which the 5 percent debt limitations are set. These inequities are further compounded by the inconsistency in the amount of local fiscal effort being invested by the counties in the construction of school facilities. Encouraging the utilization of such funds for construction purposes does contribute to the inequity of financing school buildings. Additionally, it was found that money from the state level significantly contributed to the cost of construction and consequently to the quality of the facility. Therefore, these findings strongly imply that new legislation be adopted in West Virginia to continue funding the construction of school facilities with money from the state level. The immediacy of this need is emphasized by the near depletion of Better School Buildings Amendment funds.

This study further indicates need of a funding formula for the financing of school facilities. This

formula should address the variables found to be significant contributors to the variance of school construction costs in this study. Provision should be made for the wealth of the district, for an equalized local effort by each district, and for the type of facility for which construction funds are being granted. Money generated at the county level through execution of an equalized local effort on an assessment equalized at the state mandated minimum of 60 percent of the real value, should be accrued and administered at the state level. State appropriated funds, in conjunction with resources from the equalized local effort fund, should be sufficient to finance each year's approved projects without requiring additional money from bond referenda or special levies at the county level.

Recommendations

A study of this nature only begins to identify the problems in school construction costs and gives impetus to other research that might add to the conclusions already made.

First, why was no relationship found between the percentage of instructional space and the per pupil cost when the literature indicates a strong relationship? Further study of this variable with emphasis on the various types of space and their cost might clarify this relationship to overall cost.

Second, further study into the impact of federal funds is recommended. Because of the regulatory demands on wages required by utilization of federal money, it was expected that significant variance would be contributed. However, the influence of West Virginia's state wage restrictions accounted for a great deal of the same variance in labor costs. It would appear that a nation-wide study utilizing a broader data base might be helpful in further clarifying the impact of federal funds on the per pupil cost of school construction. Further, most vocational-technical centers nationally receive federal funding; therefore, the study might best focus on impact aid money in elementary and secondary schools where cost variances would be greater.

Finally, the variables found to be of significance to the per pupil cost of new school construction in this study should be utilized to construct a funding formula for West Virginia that would equalize the local effort of each county in facility construction and, in conjunction with state appropriations, fund approved projects on a needs basis.